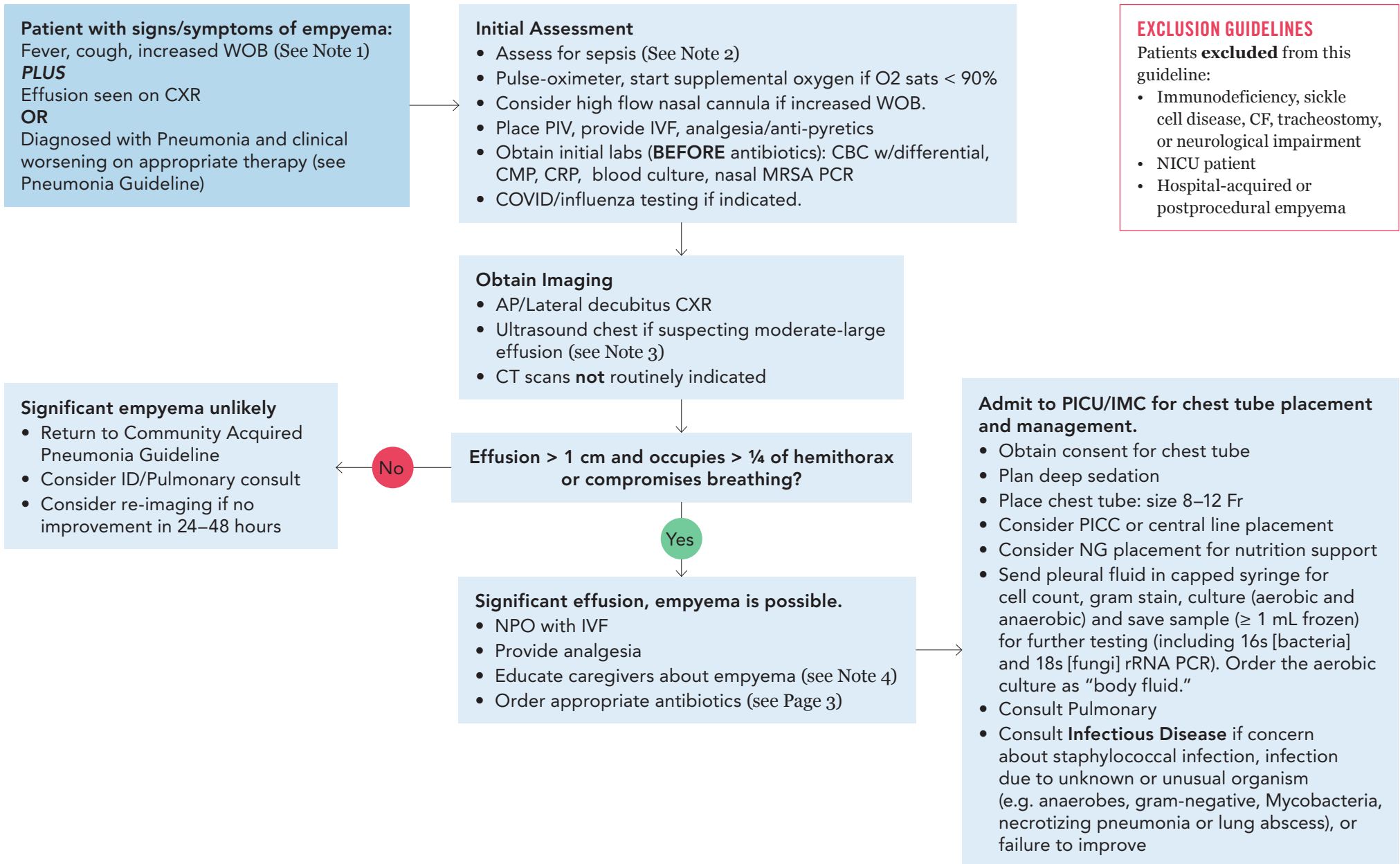
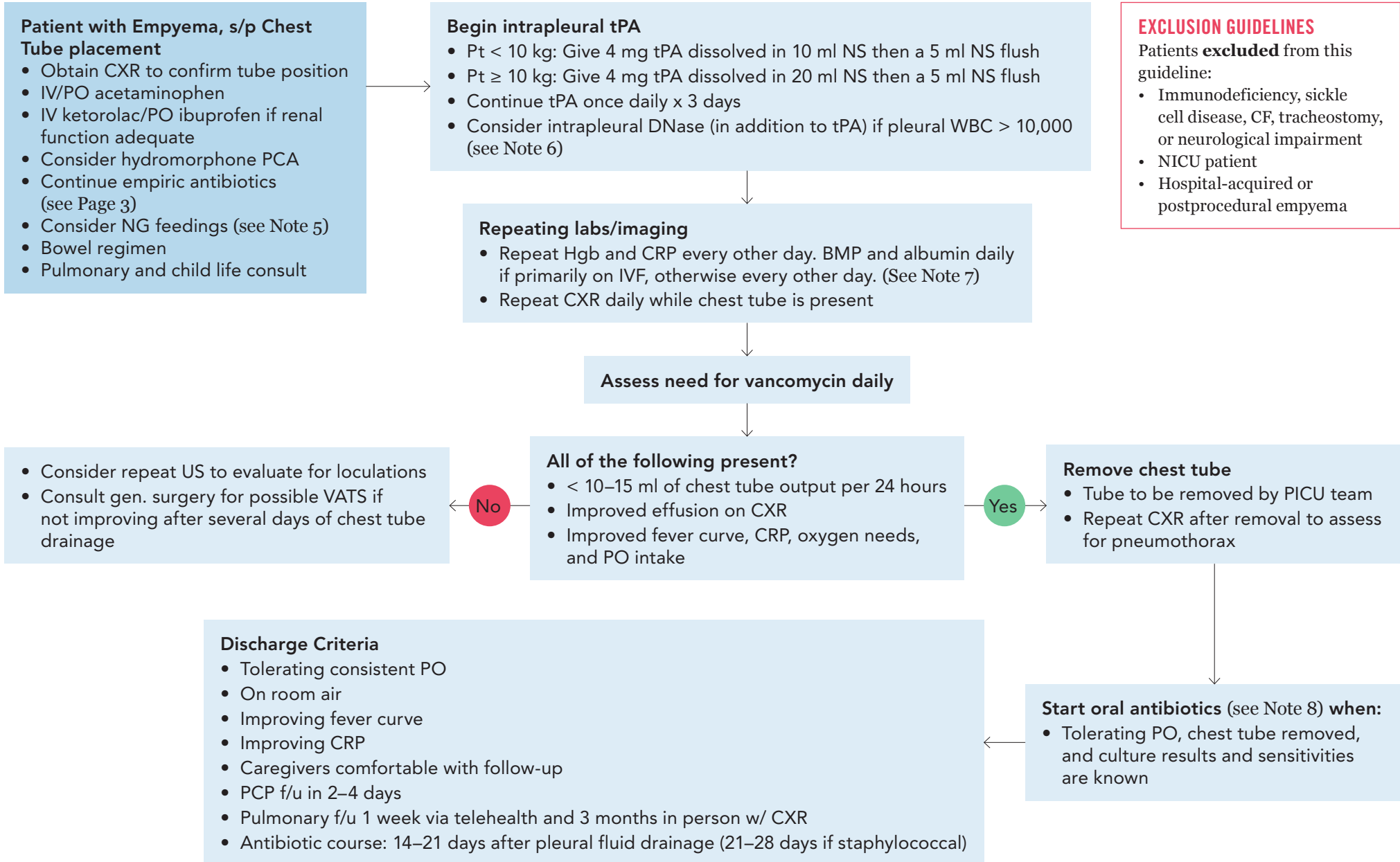


Aim: To standardize management of patients with empyema.



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EXCLUSION GUIDELINES
Patients **excluded** from this guideline:

- Immunodeficiency, sickle cell disease, CF, tracheostomy, or neurological impairment
- NICU patient
- Hospital-acquired or postprocedural empyema

Disclaimer: This guideline is designed for general use with most patients; each clinician should use his or her own independent judgment to meet the needs of each individual patient. This guideline is not a substitute for professional medical advice, diagnosis or treatment.

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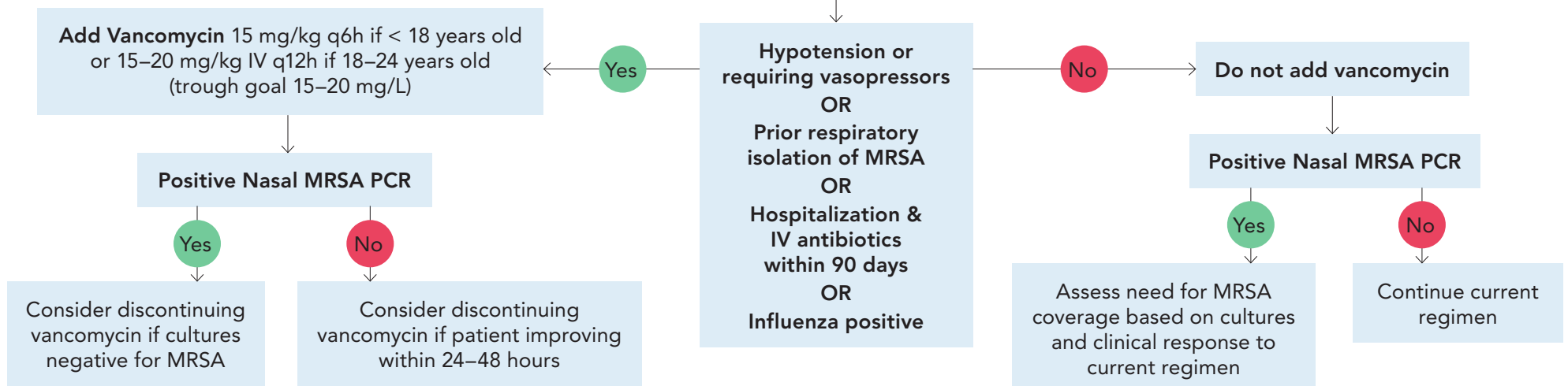
Initial IV antibiotics:

Ceftriaxone 50 mg/kg q12h (max: 2,000 mg/dose)*

If severe cephalosporin allergy:

Levofloxacin

- 6 mo to < 5 years: 10 mg/kg/dose IV q12h (max 375 mg/dose)
- ≥ 5 years: 10 mg/kg/dose IV q24h (max 750 mg/dose)



Nasal MRSA PCR

- Negative predictive value (NPV) is high (~98% based on adult data in uncomplicated CAP), so **negative** result is **good** predictor of **no** MRSA pneumonia
- Positive predictive value (PPV) is low (~50% based on adult data in uncomplicated CAP), so **positive** result is **poor** predictor of MRSA pneumonia

* **Ceftriaxone** q12h dosing is intended for better empiric coverage of MSSA compared to q24h dosing. If MSSA is isolated consult Infectious Disease.

Transition to oral antibiotics (see Note 8) when:

Tolerating PO, chest tube removed, and cultures and sensitivities known

Options based on tolerance, cultures, and allergies:

- **Amoxicillin** 30 mg/kg/dose PO TID (max 1250 mg/dose)
- **Cephalexin** 25 mg/kg/dose PO TID (max 1250 mg/dose)
- **Amoxicillin/clavulanate** 45 mg amoxicillin/kg/dose PO BID (max 2000 mg amoxicillin/dose) (use 14:1 formulation)
- **Cefdinir** 7 mg/kg/dose PO BID (max 300 mg/dose)
- **Clindamycin** 10 mg/kg PO TID (max 600 mg/dose)
- **Cephalosporin allergy: Levofloxacin** 10 mg/kg/dose PO BID if 6 months to < 5 years (max 375 mg/dose); 10 mg/kg/dose PO daily if ≥5 years (max 750 mg/dose)

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NOTE 1. Signs/symptoms of complicated pneumonia include: Cough, fever, increased work of breathing, crackles on lung exam. Differential diagnosis includes: CHF, foreign body, pertussis, measles, TB, aspiration, empyema/abscess, fungal/viral infection, atypical pneumonia, bronchiolitis/viral pneumonia, inhalation injury, asthma, lung malformation. Organisms commonly involved in empyema include: *Streptococcus pneumoniae*, *Streptococcus pyogenes* (GABHS), *Streptococcus viridans* and *Staphylococcus aureus* (MRSA and MSSA).

NOTE 2. Sepsis. Patients with bacterial infections such as pneumonia/empyema are at increased risk for SIRS (systemic inflammatory response syndrome) or sepsis, as well as respiratory failure (e.g. high work of breathing, retractions, nasal flaring, head bobbing, tachypnea).

SIRS: > 1 of (must include either temp/WBC):

- Temp > 38.5 (> 38 if < 2 mo age) or < 36
- Tachycardia (or bradycardia if < 1 yr age)
- Tachypnea
- WBC < 5,000 or > 15,000 or > 10% bands

Sepsis: SIRS + suspected infection

Severe Sepsis: Sepsis + CV dysfunction or ARDS or 2+ organ dysfunctions

Septic Shock: Sepsis + CV dysfunction that persists after ≥ 40 mL/kg NS in one hour

NOTE 3. Effusion sizing. Effusions < 10 mm, or < ¼ hemithorax are considered mild. Moderate or large effusions are > 10 mm and occupies ½ of the hemithorax or if they compromise breathing.

NOTE 4. Caregiver education. Empyema is defined as pneumonia that has extended beyond the surface of the lung to infect the space and lining of the inside of the chest wall. Patient with empyema have a 10–20% chance of failing medical therapy (antibiotics + chest tube + intrapleural medications) and may require a VATS (video-assisted thorascopic surgery) procedure to remove infectious debris from inside the chest. Average hospital length of stay for patients with empyema is 9 days. Children who experience an empyema are not typically prone to future lung infections and are expected to have normal lung function after appropriate recovery.

NOTE 5. Nutrition. Patients with empyema are at risk for malnutrition due to poor oral intake during illness and ongoing protein losses. Consider NG placement for early enteral nutrition support. Provide bowel regimen (e.g. polyethylene glycol and senna) to prevent constipation in setting of inactivity and opioid medications.

NOTE 6. Intrapleural DNase is generally not recommended. An RCT found no differences in outcomes in patients treated with both tPA plus DNase compared with tPA plus placebo (Livingston et. al. JAMA Pediatrics 2020). Consider in patients with a pleural WBC of > 10,000. DNase 5 mg is dissolved in 10 ml NS for patients < 10 kg and 20 ml NS for patients ≥ 10 kg and followed by 5 ml NS. DNase is administered at least 2 hrs after tPA. DNase is never used as the sole intrapleural agent.

NOTE 7. Lab notes. Close attention must be paid to fluid balance and sodium as patient with empyema are at risk for SIADH (syndrome of inappropriate antidiuretic hormone secretion). Albumin may become very low in patients with empyema (< 2.0) due to leakage of proteins into the pleural space and has been identified as a predictive risk factor for empyema in patients suspected of having pneumonia (Chalmers et. al. 2009).

NOTE 8. Antibiotic notes. A comparative effectiveness study, using propensity score-weighted logistic regression, found no difference in outcomes between patients discharged on oral antibiotics compared with those discharged with IV (e.g. PICC) antibiotics (Stockmann et.al. 2015). A multicenter cohort study of 2123 children with parapneumonic effusion and empyema had similar findings (Shah et.al. 2016). **Duration** of antibiotic therapy is influenced by the organism, adequacy of source control, and clinical response. For non-staphylococcal disease, typical antibiotic course is 14–21 days after pleural fluid drainage. Staphylococcal disease may require therapy for 3–4 weeks. Choose the **narrowest** appropriate oral antibiotic based on susceptibility results (e.g. amoxicillin for *Streptococcus pneumoniae* or *Streptococcus pyogenes*).

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Key Outcome Measures

- Proportion of patients evaluated for empyema with chest ultrasound vs. chest CT
- Proportion of patients with negative nasal MRSA PCR and vancomycin discontinued

Key Balancing Measures

- Length of stay
- Unplanned outpatient visits/readmissions in first 14 days

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